Designing the most probable final pit limit of open pit mines considering price uncertainty

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English Extended Abstract

Summary

Open pit design and production scheduling considering the commodity price uncertainty is one of the important issues in the field of open pit mining, so that mine design and planning regardless of price uncertainty leads to erroneous assessments and non-operational production scheduling, which itself increases the investment risk. The amount of reserve that can be extracted and the location of surface facilities directly depends on the final pit limit. In this paper, a mathematical algorithm based on Monte Carlo Simulation and Lerch and Grossman algorithm is presented, which is able to calculate the expected value of blocks based on the metal price history and estimating its distribution function and get the most likely final pit limit. This pit can be the basis of long-term mine production planning as well as a criterion for locating surface facilities.

Introduction

The aim of the planning process for an open pit mine is usually to find optimum annual schedules that will give the highest Net Present Value (NPV). The primary input of this procedure is an economic block model, which includes a set of mining blocks representing the ore body and the surrounding rock. Net economic value is assigned to each block based on the revenue of recoverable metal content in a given block and subtracting all the operating costs, comprising mining, processing, refining, and selling costs. An economic evaluation of each block requires the estimation of ore tonnage and grade of mining blocks as well as some economic parameters such as metal prices and operation costs. In the current pit design approaches, the block economic values are calculated using a fixed known value. In this paper, using the metal prices in the past as well as the Monte Carlo simulation method, the most probable ultimate pit is obtained.

Methodology and Approaches

In this article, the price distribution function of the metal price (copper) was obtained using the metal price history. Then 100 prices were simulated using Monte Carlo simulation and the expected value of each block was obtained using these simulated values of other fixed technical and economic parameters. Finally, by using these values and using the NPV Scheduler software, a single optimal pit was obtained.

Results and Conclusions

In this article, the expected value of the blocks was obtained using the Monte Carlo simulation method, and then the optimal pit, which is actually the most probable pit, was obtained. Because the price history of the metal is considered in the design process, the obtained pit has little sensitivity to the changes in the price of the metal in the future.